

Wuppertal Institute
for Climate, Environment
and Energy

Sustainable Low Carbon Society

Research at the Wuppertal Institute

LCS-Research Net
Researchers Meeting Triest
1/2 April 2009

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Research Group
Future Energy and Mobility
Structures

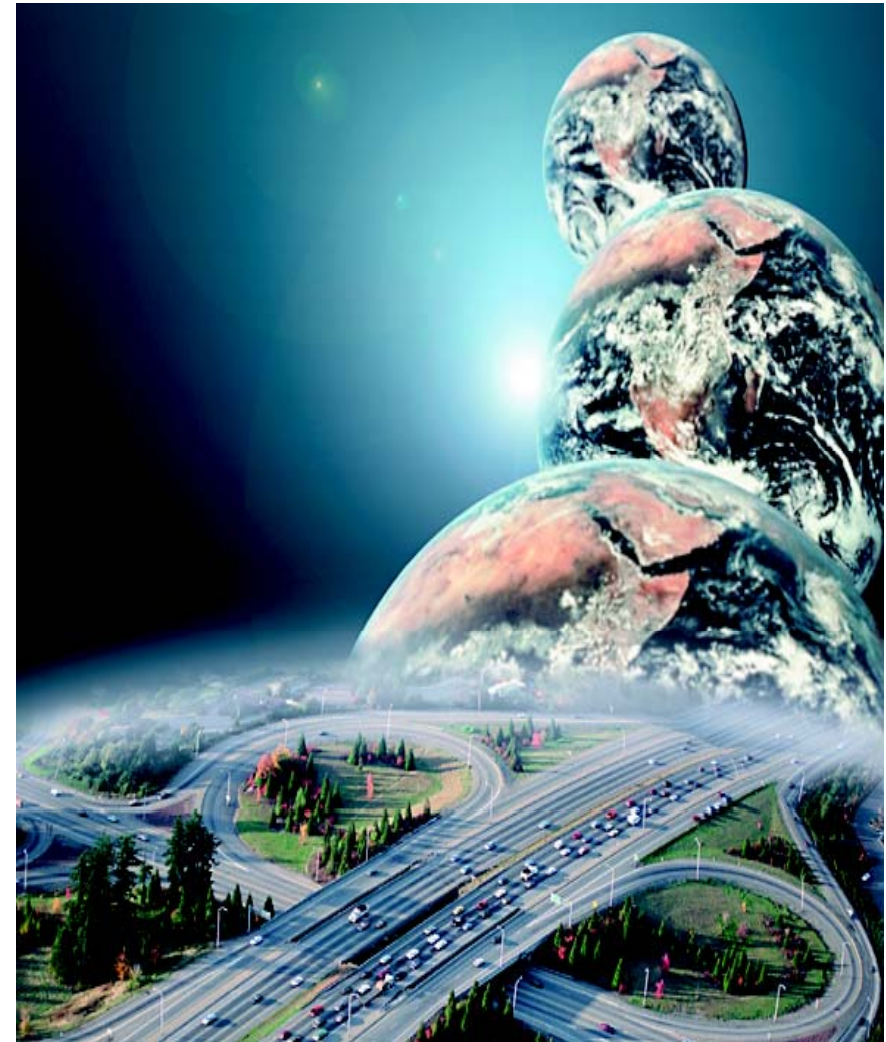
Mission

Application-oriented Sustainability Research

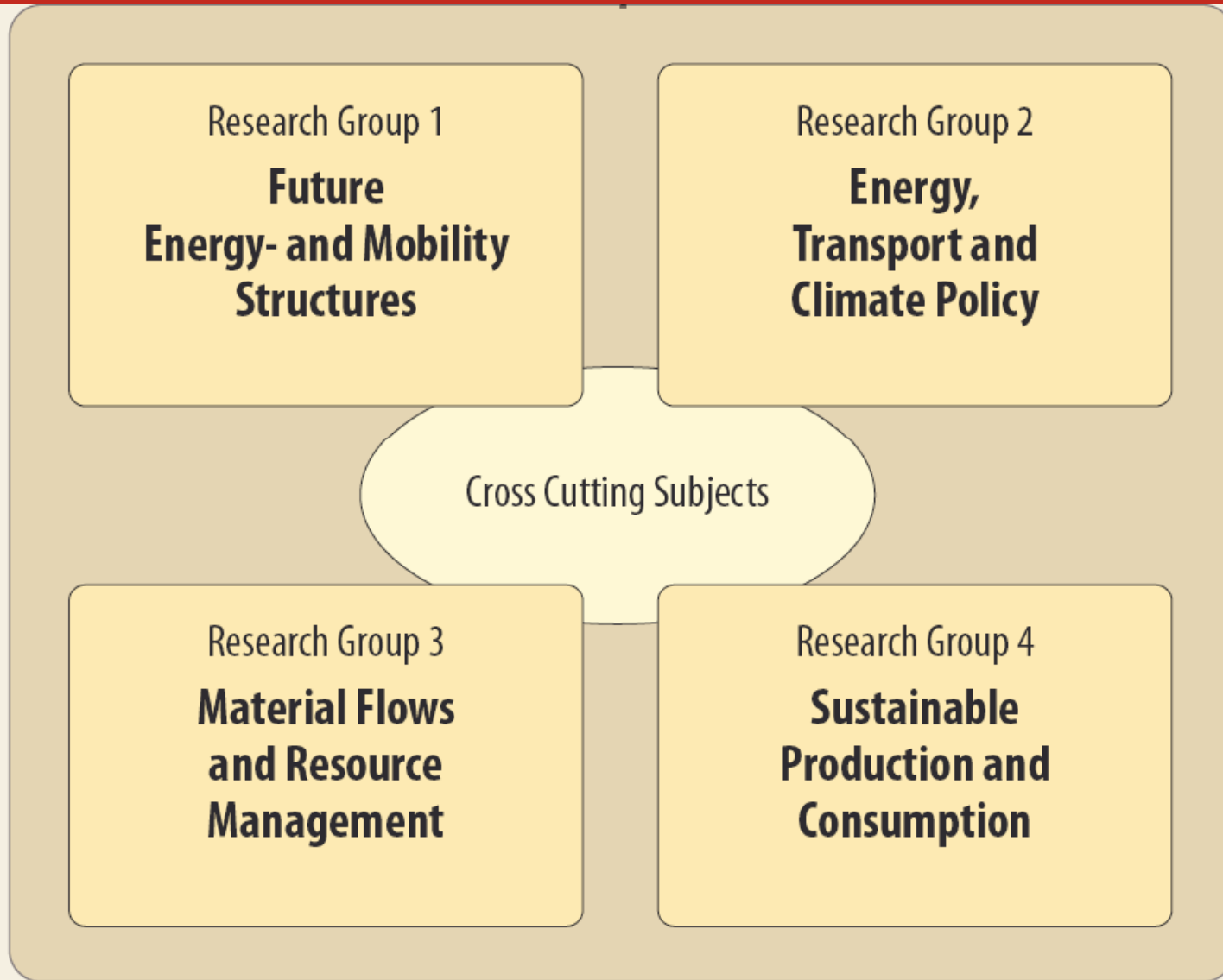
The WI explores and develops **models, strategies and instruments** to support a **sustainable development** at local, national and international levels.

Sustainability research at the WI **focuses on ecology** and its relation to economy and society.

Our research analyses and initiates **technological and social innovations** that **decouple** economic growth from nature use and wealth.



Wuppertal Institute for Climate Environment Energy



UNEP/Wuppertal Institute
Collaborating Centre on
Sustainable Consumption
and Production GmbH

Low Carbon, Low Risk, Low Material Society Research topics at the WI / In Germany

- **Sustainable Society Research at Wuppertal Institute**

- The WI has a long tradition in doing long term sustainability research
- LCS-Vision / long term technologies and scenarios
- Low Material Society scenarios and instruments
- Strategies and policies towards LCS (time horizon 2020/30)
- Sustainable Production and Consumption (WI-UNEP Centre: CSCP)

- **LCS-Research in Germany (Scenarios on sustainable energy futures)**

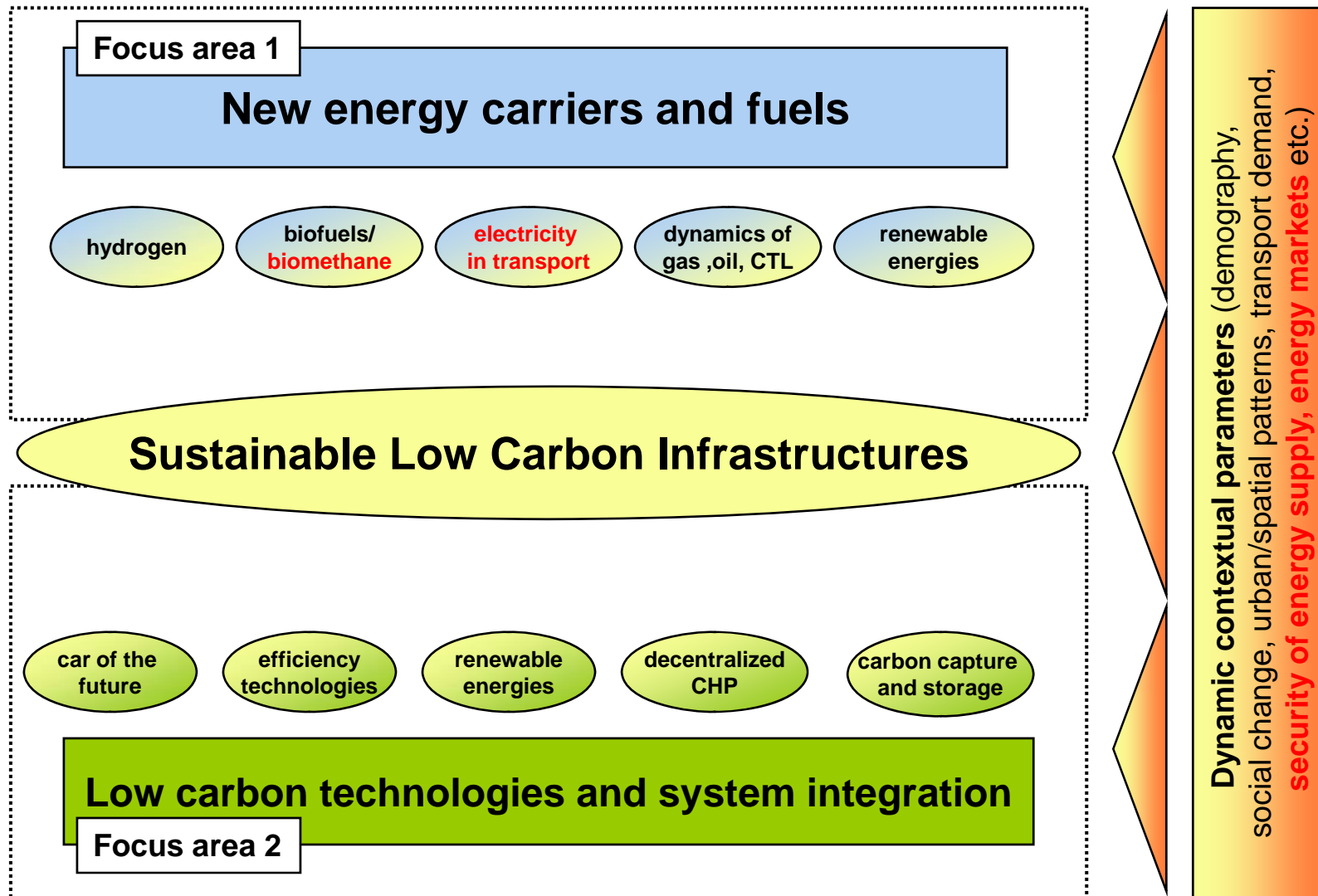
- Long term energy and emission targets have been discussed since 1990
- Several institutes have made long term energy scenarios (for 2050)
- Mainly focused on the German energy system
- A strong German network on LCS research is missing

Important LCS Research by WI

- **1990: Parliamentary Enquete Commission “Protection of the Earth”**
 - Setting of a long term target: -80% GHG by 2050
 - Prof. Hennicke was member of that commission
- **1995: WI flagship study: Sustainable Germany**
 - Groundbreaking study for German sustainability discussion
 - Mainly qualitative recommendations on “basic needs”
 - First quantitative scenario analysis for 2050
- **1996: Long term integration of renewable energies (EU, 2050)**
- **2000: Long term energy scenarios for Germany (Fed. Environmental Agency)**
- **2002: Parliamentary Enquete Commission “Sustainable Energy Future”**
 - Prof. Hennicke & Dr. Lehmann were members of that commission
 - Quantitative energy scenarios for Germany: -80% GHG by 2050
 - Competing analysis WI vs. IER
- **2004: Ecologically optimised expansion of renewable energies**
 - Quantitative energy scenarios for Germany: -80% GHG by 2050, with DLR
 - Basic studies for the annual “Leitstudie 2050” of German MOE
- **2009: Pathways to a carbon free Munich 2058**
 - Commissioned by Siemens as part of their sustainable urban infrastructures project

Research Profile of Research Group 1

Future Energy and Mobility Structures



LCS scenario research (approach)

- **Energy system modelling / time horizon 2050:**
 - Various scenario analyses from municipal to global level
 - Additional: strong track of mid term scenarios
- **Methodology**
 - Bottom-up demand oriented technological energy modelling
 - Detailed technological analysis of the energy systems
 - Policy based modelling approach
 - Research developments planned
 - Stronger linking to LCA/Dynamic LCA
 - Inclusion of material system into analysis
 - Interaction / linking with economic models (GE, PE, Growth models, others) --> new Project: Long term climate

LCS technologies research topics at WI

- **High efficient demand side systems**

- Building structures
- Electric appliances

- **Low Carbon infrastructures**

- Efficient energy supply (heat, gas, electricity, CHP)
- Transport and mobility structures

- **Renewable energies**

- System integration of all types of renewable energies
- Focus on biogenous energy carriers

- **Carbon Capture and Storage**

- Potentials and pathways
- Innovation and diffusion

- **Systems integration of new transport energy carriers**

- Hydrogen
- Bio fuels
- Electricity

- **Various third party funded research projects**

- TA/LCA for certain technology paths
- Scenario based systems integration analysis
- Market potential analyses for stakeholders

Selected project: Munich 2058 – Pathways to a Carbon Free Future

- **Blueprint for the restructuring of cities**
 - 50% of the worlds population lives in cities, but they consume more than 70% of the energy
 - cities are determining nodes of ressource use and core to the solution
 - 50% of cities of 2050 are still to be built
 - 50% have been already built (including infrastructural backbones)
- **Project components:**
 - Technology matrix
(100 local technologies for a CO₂ free future)
 - Scenario analysis „Vision Munich 2058“
 - Two scenarios (Target & Bridge)
750 / 1300 kg CO₂/cap
 - Pilot district „CO₂ free“ by 2038
 - *Economic chances of being a low carbon frontrunner*



Our Definition of “Low Carbon Society”

- **The term has not yet been used (rather: Sustainable Energy System)**
- **How low? – Long term target**
 - 2°C-Target of the EU
 - 60% Reduction of GHG emissions vs. 1990 worldwide (UN Foundation)
 - 80 - 95% Reduction for industrialised countries (EU Environment Ministers)
 - 80% Reduction vs. 1990 (German target, Parliamentary Enquete Commissions)
- **“Low Carbon” has to be achieved within a framework of other sustainability criteria**
 - Material flows and availability of resources
 - Security and Risks
 - Sustainable production and consumption

First expectations to the LCS-Rnet / Ideas for Research questions

- **Development of a “LCS” is one of the key challenges for the coming decades for all countries, for the cities, for the economy**
 - Agenda setting in order to speed up development of concepts, strategies and technologies
 - Creation of awareness for the long term perspective
- **International exchange and learning about LCS**
 - Concepts (comparison, pros and cons of approaches)
 - Methodologies
 - Policies and strategies
- **Improving LCS research and its scientific impact**
 - Exchange of methodologies
 - Joint efforts to publish LCS research results / intensify scientific discussion
- **Defining of LCS Roadmaps**
 - Specific strategies for industrialized/developing countries
- **Specific questions for research**
 - What are LCS concepts for nations / cities / companies etc.
 - What are the LCS technologies? Which is the demand for technology policy?

Ideas for Research questions

- ***What are the questions to solve for achieving a global LCS by 2050?***

- *Technical, conceptual, behavioural, political, institutional*
- *Which time frame is appropriate for which research question?*
- *Which approaches might be fruitful?*

- **Systems, scenarios and futures research**

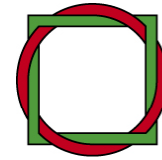
- Which methodologies are used for LCS research and are they appropriate?
- Which time frames and which regional scope are appropriate?
- Which concepts/visions for LCS already exist? (e.g. -80% scenarios; 2000 Watt society; solar society ...)

- **How to implement changes towards LCS?**

- Analysis of technology needs: Are there robust technologies? What are the needs and possible priorities for R&D policy?
- Analysis of behavioural changes: How can behavioural changes be introduced?
- Analysis of institutional and societal changes: Which institutions do we need and how can they be changed?
- Analysis of policy towards LCS

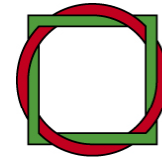
Added value of the LCS Research network

- Achieving a global LCS will be a core challenge of society
- The network will start to stronger link systematic thinking of what that is
- It cannot cover all possible facets of LCS in depth
- Its added value is in promoting the topic/issue
 - It may promote more conceptual and analytical work o the topic
 - It can thus guide more specific research e.g. in modellers communities etc.
 - Its focus should be on the systematic thinking/approach



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Thank you!

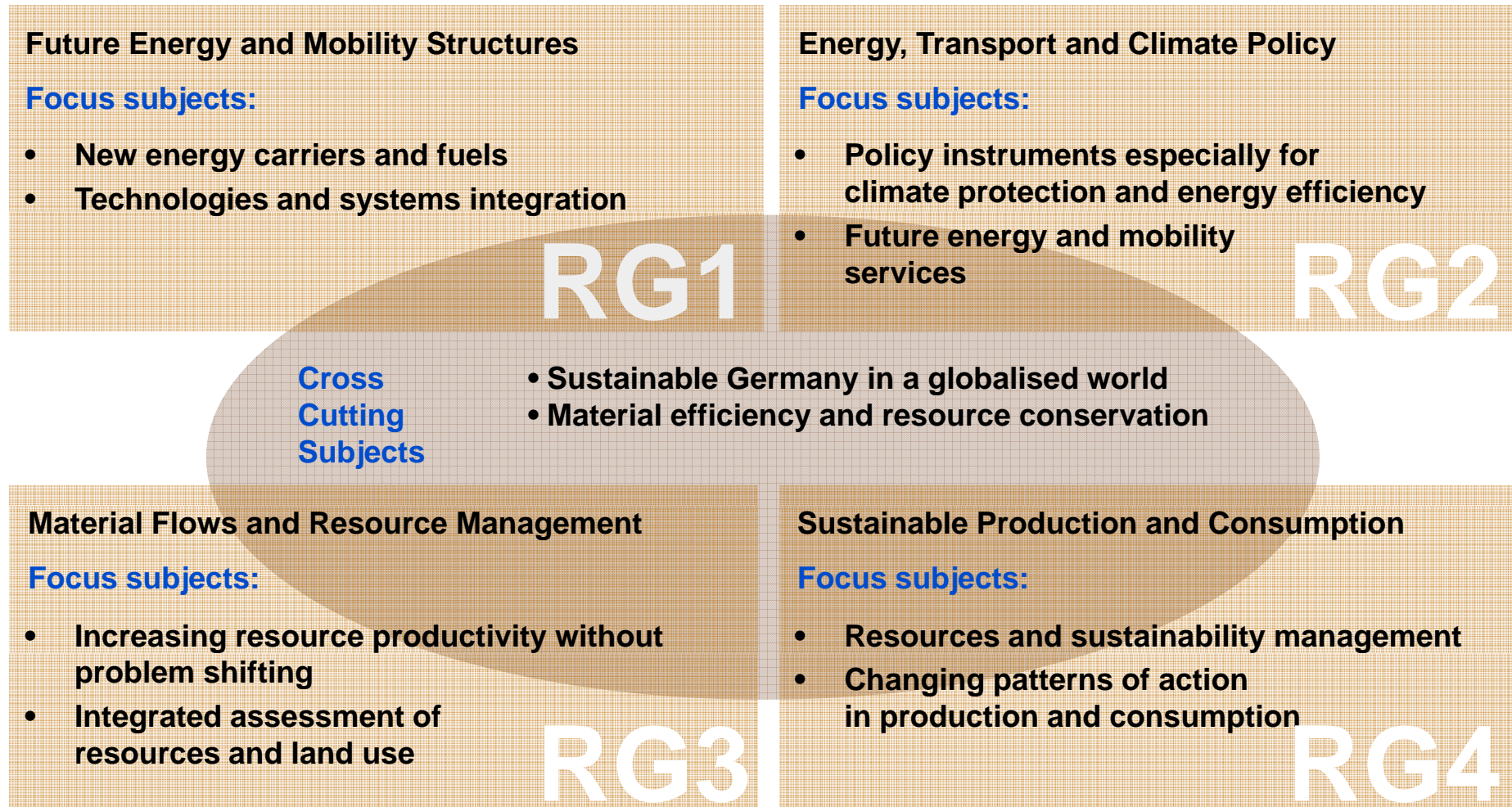


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Research Topics and Organisation

Research Groups, Focus Subjects, Cross Cutting Subjects



LCS scenario research (examples)

- **Energy system modelling / time horizon 2050:**

- The Global Factor Four Scenario (Expo 2000)
- German sustainable energy futures (German Enquete Commission 2002)
- Energy scenarios for the integration of renewable energies (UBA 2004)
- Munich 2058 – Pathways to a Carbon Free Future (Siemens 2009)
- Alternative Energy and Climate Scenarios for the Czech Republic (2009)

- **Methodology**

- Bottom-up oriented technological energy modelling
- Detailed technological analysis of the energy systems
- Based on broad work on medium time scale
- Developments planned
 - Stronger linking to LCA/Dynamic LCA
 - Inclusion of material system into analysis
 - Linking with economic models (CGE, others)

Research Group 1 Profile:

long term technologies and scenarios for LCS

- **Research group 1: Future Energy and Mobility Structures**
 - Interdisciplinary Research Team
 - 24 Researchers (engineers & planners, natural & environmental scientists, systems analysts, economists & social scientists)
 - 7 PhD students
- **Development of LCS-Scenarios**
 - National level (Germany, Czech Republic)
 - Regional / municipal level
- **Analysis of core technologies and infrastructures for LCS**
 - Methods: TA, LCA, market potential analysis
 - Focus: System integration of LCS-technologies
 - Focus: New energy carriers and fuels

Selected project 1: GermanHy

ur Anzeige wird der QuickTime™
Dekompressor „
benötigt.

GermanHy

Targets and **background**

- Basic research for the German Fuel Strategy
- On behalf of BMVBS and National Hydrogen and Fuel Cell Technology
 - ⇒ **integrated multicriteria scenario approach**

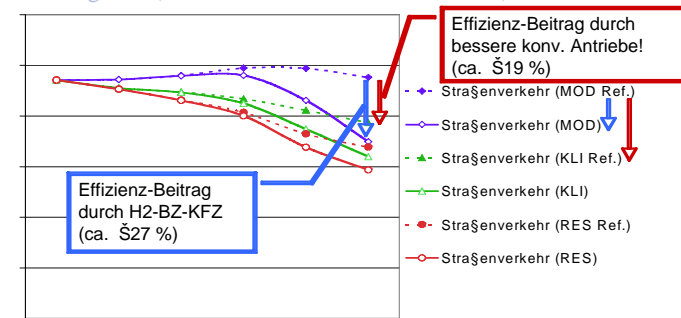
Results

- Hydrogen & fuel cells can play an important role in transport energy (up to 70% of vehicles by 2050)
- However, efficiency (conventional and H₂/FC) is the core strategy in all scenarios
- Batteries are a core technology to future mobility --> Hybrids can be a “bridge”
- Bio fuels become increasingly important as well
- CCS and strong development of renewables needed
 - ⇒ **H2 no “silver bullet” strategy**
 - ⇒ **“needs” efficiency, renewables & batteries**

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GermanHy

Entwicklung des Endenergiebedarfs im Straßenverkehr
im Szenariovergleich (MOD-Ref und MOD-Hoch)



WOHER KOMMT DER WASSERSTOFF? 20

Forschungsgruppe Zukünftige Energie- und Mobilitätsstrukturen

Vision und Mission

Vision

- **Die FG 1 arbeitet an der Realisierung eines nachhaltigen und vor allem kohlenstoffarmen Energie- und Verkehrssystems bis zur Mitte des 21. Jahrhunderts**

Mission

- **Bereitstellung von Orientierungswissen über zukunftsfähige (Infra-)Strukturen**
 - eines Energie- und Verkehrssystems der Zukunft
 - einer Sustainable Low Carbon Society
- **Entwicklung und Diskussion quantitativ hinterlegter Strategien**
 - A) Entwicklung von lang- und mittelfristigen Szenarien
 - B) Analyse und Bewertung zentraler Low-Carbon-Technologies (TA, LCA)
(Systemintegration, potentielle Lösungsbeiträge, Rück- und Wechselwirkungen, potentielle Lock-In Situationen, F&E-Erfordernisse)
- **Bereitstellung dieses Know-hows für konkrete Politiken und Strategien**
 - Konzepte für die Beschleunigung von Innovation und Diffusion
 - Optionen für den Technologietransfer
 - Szenariogestützte Marktpotentialanalysen für Zukunftstechnologien
 -

Forschungsagenda der FG 1

Die Themenfelder

